DOCUMENT RESUME

ED 188 875 SE 031 017

TITLE Energy in the Ecosystem. A Curriculum Guide for Elementary and Secondary Teachers.
INSTITUTION New Jersey State Dept. of Environmental Protection, Trenton.
SPONS AGENCY Office of Education (DHEW), Washington, D.C. Office of Environmental Education.
PUB DATE [80]
GRANT G007701233
NOTE 14p.

EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS *Ecology; *Elementary Education; *Energy; *Environmental Education; Food; *Natural Resources; *Secondary Education; Wildlife Management

ABSTRACT

This curriculum guide deals with natural resource management in a way that includes man as user and manager of these resources. The role of energy in the ecosystem is explained and examined. Learning activities are included for both elementary and secondary students. The text also includes material for class discussion, recommended films, and references. (SB)

****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

JUN 1980
RECEIVED
ERIC/TM

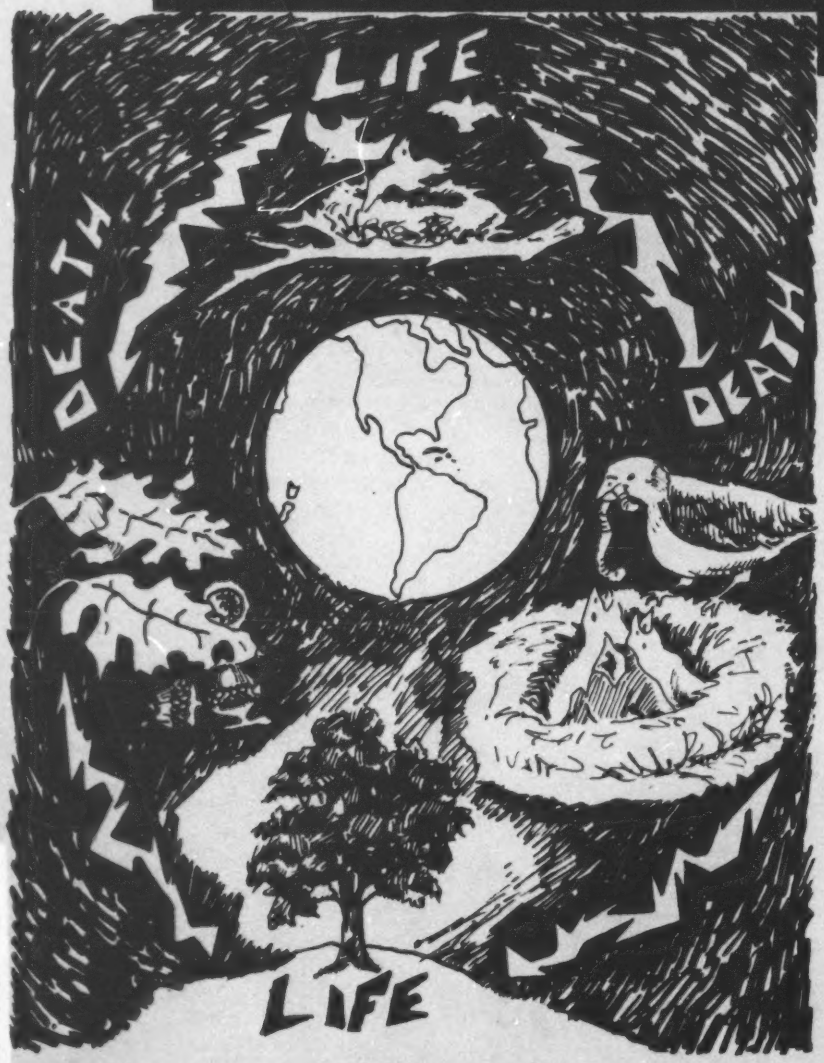
ED188875

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
NATIONAL INSTITUTE OF EDUCATION

THIS DOCUMENT HAS BEEN REPRODUCED EXACTLY AS RECEIVED FROM THE PERSON OR ORGANIZATION ORIGINATING IT. POINTS OF VIEW OR OPINIONS STATED DO NOT NECESSARILY REPRESENT OFFICIAL NATIONAL INSTITUTE OF EDUCATION POSITION OR POLICY

Energy in the Ecosystem

A Curriculum Guide for Elementary and Secondary Teachers



Developed by

**Department of Environmental Protection
Division of Fish, Game, and Wildlife
Wildlife Education Unit**

**Funds for this project were made available by a grant from Health, Education, and Welfare, Office of Education, Office of Environmental Education.
(Grant Number G007701233)**

SE 031 017

State of New Jersey

Brendan Byrne,
Governor

Department of Environmental Protection

Jerry Fitzgerald English,
Commissioner

Division of Fish, Game, and Wildlife

Russell A. Cookingham,
Director

PROJECT PERSONNEL

Robert Byrne	Project Director Wildlife Education Specialist New Jersey Division of Fish, Game & Wildlife
Robert McDowell	Project Supervisor Senior Wildlife Education Specialist New Jersey Division of Fish, Game & Wildlife
Donald Kay	Consultant—Secondary Level Hopatcong High School 9th.-12th. Grade Science
Rena Penkala	Consultant—Primary Level Grice Middle School 8th. Grade Science
Jerry Schierloh	Consultant—Science Assistant Director and Assistant Professor of Environmental Studies New Jersey School of Conservation
Regina Kelly	Consultant—Social Sciences Assistant Professor of Environmental Studies New Jersey School of Conservation
Dr. Leonard Wolgast	Consultant—Evaluation Assistant Professor of Wildlife Management Rutgers University
Lawrence Herrighty	Consultant—Evaluation Graduate Assistant Wildlife Management Rutgers University
Gene Feller	Artist

DEAR EDUCATOR:

This Wildlife and Environmental Education Teaching Unit is one of a five part series that has been developed under the auspices of U.S. Office of Environmental Education. The need for this educational package was recognized after the New Jersey Division of Fish, Game, and Wildlife conducted several Teachers Workshops regarding natural resource management. After an extensive search it became apparent that very little curriculum material was available that dealt with resource management in a way that included man as user and manager of these resources. Within this shortcoming was an even greater assumption that certain student entrance level skills and knowledge were firmly established when, in fact, they were almost non-existent. We hope this material will help overcome these problems.

Robert Byrne

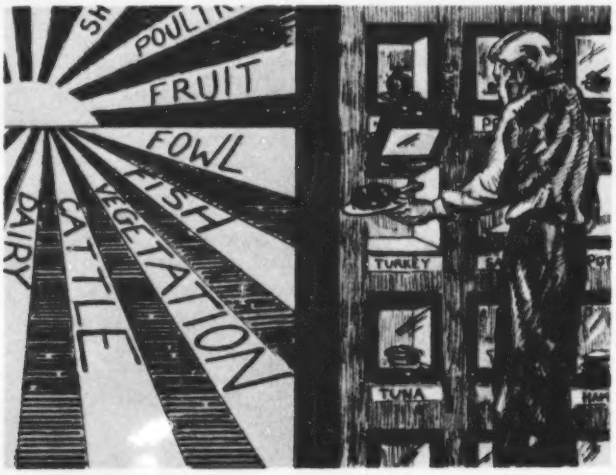
ENERGY IN THE ECOSYSTEM

Common Misunderstanding:

Very few people know the origin of their food energy and the importance of death as a life-giving energy transfer process. No organism (including man) is exempt from participating in this process.

Resultant Problems:

Because there are few obvious connections between humans and their food, an unrealistic attitude toward the food chain has developed. The death of individual organisms which are involved in this energy transfer process is often viewed as tragic. Idealized labels of "good" or "bad" are often given to animals based upon how they obtain their food energy.



Learning Concept Needed:

All food energy comes from the ecosystem. Obtaining this energy involves the death of individual organisms within the overall population. This is an energy transfer process in which all organisms (including man) are involved with.

Concepts (Umbrella Ideas)

1. All energy that powers the living systems on this planet originates as light energy from the sun.
2. The light energy from the sun is stored in green plants through a process called photosynthesis.
3. The stored energy in plants is used (consumed) by other organisms. This *energy transfer* process is called a food chain. The combination of many food chains (energy transfers) is a food web.
4. No matter what form this food energy comes in, it is traceable back through the ecosystem and ultimately back to the sun. (There is no such thing as a free lunch!)
5. The manner in which an organism obtains its food energy (trophic or feeding level) is a characteristic of that organism. Labels of "good" or "bad" have no place in a food chain. All organisms are equally important in this energy transfer process.
6. The death of individuals within a population is a necessary and unavoidable part of this energy transfer process.
7. Humans have modified the "content" of their food chain to be more convenient for their own well being, but have not altered the "context" of these energy transfers at all. Human food still comes from the ecosystem and still involves the death of individual organisms. However, in most cases, the hand that kills it is not connected to the mouth that chews it. (This includes carrots as well as cows).

BEHAVIORAL OBJECTIVES:

The student will be able to:

1. define the following terms:
   ecosystem, plant, animal, food chain, food web, primary producer, consumer, predator, prey, de-

composer, herbivore, carnivore, omnivore, scavenger, photosynthesis;
2. diagram a simple food chain;
3. diagram a simple food web;
4. explain the myth of "good guys" and "bad guys" in the ecosystem;
5. discuss the impact of the death of an *individual* in the energy transfer (food chain) process; (secondary)
6. discuss impact of the death of a *population* in the energy transfer (food chain) process; (secondary)
7. identify the feeding levels that humans occupy and trace a typical meal back through the ecosystem to its source;
8. describe food gathering similarities and differences between man and other animals.

INTRODUCTION TO ENERGY IN THE ECOSYSTEM

Food is an energy source that most people overlook when they consider their energy needs. This energy, like all other forms, comes from the ecosystem.

Man has modified much of his environment in order that his food energy needs are met more conveniently. However, his modifications have not changed the source of his food or the basic mechanisms of this energy transfer at all. From an ecosystem point of view there is no such thing as a free lunch!

Unfortunately, most people do not trace this energy back any further than the local supermarkets where it was purchased. Because of this, a complete awareness of the impact that their existence has on the environment is very difficult to obtain.

Humans have, by making food gathering more convenient, "hidden" many of the less "pleasant" but very real aspects (like the death of individual organisms) of this energy transfer process. This has also encouraged the labeling of various animals as "good" or "bad" because of the way that they obtain food.

All of these situations are counterproductive to the long-term human goal of enhancing the ecosystem's productivity.

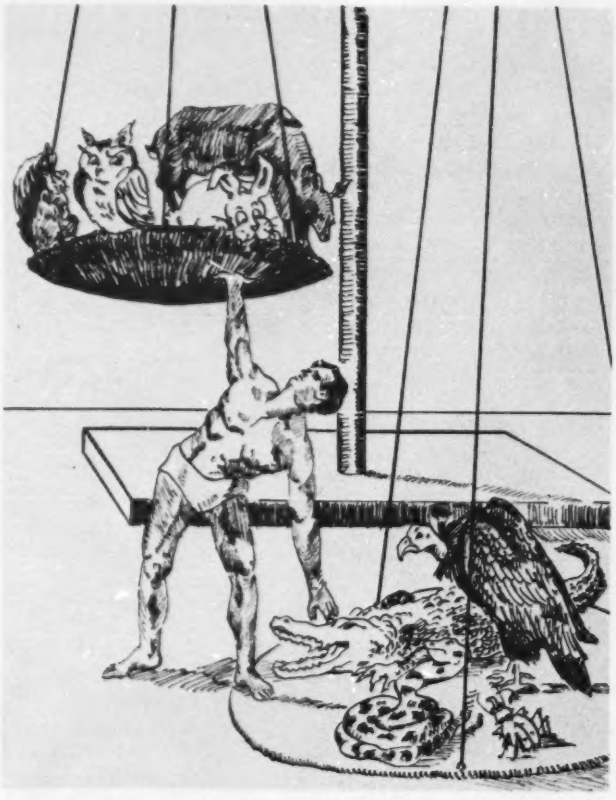
Class Discussion:

It is often heard that "you are what you eat." But just what is this stuff called food? Where does it come from? Why do we have to eat it? And why is it important that we know about this process?

Basically, food is energy; energy that has been "captured" from the sun and transferred to the various food stuffs that we consume. The process that is involved is primarily an energy transfer process, and, as such, it is necessary for our survival and that of all other organisms.

Recognition of the various steps involved is important because it ties man directly to the ecosystem. Direct connections between man and the ecosystem are often overlooked by the average person. However, all activities that humans are involved with affect the ecosystem.

This transfer process generally involves herbivores (animals that eats plants), carnivores (animals that eat animals) and decomposers (organisms of decay), but could involve omnivores (animals that eat both plants and animals).



The way an animal obtains food has influenced man's attitude toward that animal. Both predators and scavengers generally have "bad guy" images. However, these labels are unjustified and have no place in describing an animal's place within the ecosystem.

A predator, by definition, is an animal that kills its own food. Any person who has gone fishing and eaten the fish that he or she has caught is participating in the food chain as a predator. Predators are not "bad"; they are doing what nature has designed them to do.

Some anthropologists (see references 39 and 41) believe man evolved into man because of his predatory nature.

Scavengers, also, have a "bad" image. They, by definition, do not kill their own food, but allow some other organism to do that for them.

Most humans in today's society would also fit into this definition. The average person does not kill the cow that they get their hamburger or steak from. Nor do they kill the carrot that they put in their soup!

Other anthropologists believe that this scavenging ability was a key point in man's evolution (see reference 42).

Death within the ecosystem is rarely considered when people go shopping (scavenging) in the local supermarket. Nor is it discussed at the dinner table while they eat a dead chicken!

Modern man has modified the "content" of his own food chain so that it is more convenient (and efficient) to obtain his own food. However, these modifications have not changed the steps involved and in many cases decreased the overall productivity of the ecosystem.

Modern man rarely has to deal with the "warm limp body" that he turns into his dinner. The cultural "unpleasantness" that is involved with this food gathering process is a "hidden" cost of that food. However, from the ecosystem point of view the price is still the same. No organism is exempt from participating in the life-giving, energy transfer process of death.

Supportive Activities:
Elementary and Secondary

1. Take a checkerboard and place it on the ground. Count the squares that are illuminated by sunlight. Calculate the percentage. Repeat this activity in various habitats (forest, brushy areas, a field, etc.) and compare the types (species) and amounts of plants found in each area with the calculated percent of sunlight. Which areas use sunlight more efficiently? How is this related to overall productivity of the area? The animal populations in that area? (references 43, 5, 14, 20)
2. Show students a series of photographs of a variety of animals. Include animals considered predators, prey, herbivores, carnivores, omnivores, scavengers, and decomposers. Make a food chain using these pictures. Have the students list the animals on a piece of paper in order of those liked *most* to *least*. Have them briefly state why. Discuss whether these animals are really "good" or "bad". (references 43, 40, 34, 35, 14, 12)
3. Have your students list the importance of green plants, herbivores, carnivores, and decomposers in the food chain. Discuss the effect that the death of individuals within these trophic (feeding) levels has on this energy transfer process. Discuss the effect that the death of the entire trophic level (population) would have on this energy transfer process. (references 13, 14, 43, 15)
4. Have your students keep a log of what they ate during the course of one week. After the week is up, make a composite list from all the students. Try and determine how many animals (both species and individuals) were killed to fulfill their food energy needs. How much grain was used (killed) to feed the animals? Mentally expand this activity to include the town, state, nation, for one week, one month, one year, etc. How many organisms died for your life? Is this avoidable? (Remember you still have to kill carrots!)
5. Have your students bring in pictures, empty cartons, containers, etc. of various food products. Be sure to include all types of foods. Breakdown the ingredients into three categories: a) plant products, b) animal products, c) chemical additives. (A short discussion on the reasons for chemical additives might be in order at this point). Trace these products back to their source in the ecosystem. Arrange and construct a bulletin board food chain using the materials that the students brought in. Discuss the interactions between primary producers, primary consumers, and secondary consumers. How does man fit into these interactions? Challenge the students to find some food that does not come from the ecosystem. (Offer a reward of one "free" lunch!)
6. Discuss how man gets his food. Make pictorial representation of the steps involved. Compare this with the one you made earlier using "natural" food chains.
7. Set up the "Food Chain Game—The Web of Life" adapted from the Arizona Department of Education, *Teachers Resource Guide for Environmental Education.* (reference 28)

"The Food Chain Game—The Web of Life"

A game which demonstrates interdependence between living organisms and their environments.

Equipment needed:

A large ball of string or colored yarn with a small sign for each participant.

Procedure:

Make a sign for each student. The signs can be simply lettered or a project for your art class.

Each sign should represent some element of the environment. Start off by using the immediate neighborhood. Suggested signs could be: sun, water, air, soil, native plants (grasses, trees, bushes). Now add man's plants such as corn, wheat, apple trees; native animals (herbivores, carnivores, omnivores, decomposers). Add domestic animals. Make the list fit your community.

Seat the students in a tight circle; give each student his sign. Using an inquiry technique, start the flow of energy from the sun: Where does it go and how? When the web is complete, talk about what happens to the web when something happens to any unit. Add in your own problems: a forest fire, flood damage, drainage project. etc.

Try the *Web of Life* in Social Studies by substituting elements of the man-made community: a church, service station, bank, lumber mill, grocery

store. What are the relationships and interrelationships? Use the *Web of Music*. Have your students portray instruments in an orchestra. How does each instrument relate to the final sound?

Try different ecosystems: desert, forest, polar ice, African veldt. There is almost no end to the teaching capacity of this game.

8. Take a trip to the zoo. Try to discover the various food sources that the animals utilized when they were not in the zoo. Construct various food chains using the animals that were observed. Emphasize any adaptions that the animals might have to help them utilize these food sources more effectively.

Secondary

9. Assign each student from one to several animals (be sure to include invertebrates as well as vertebrates) and have them research the food habits of each species assigned. Use the information collected to make visual displays of the food chains and food webs that they have discovered. Discuss and explore the students attitudes regarding "good guys" and "bad guys" within the species that were assigned. (references 2, 11, 16, 29, 33, 46)
10. Take a field trip to a stream, pond, or lake. Seine and collect organisms from which a model food chain can be set up. Special emphasis should be placed upon the numbers of individuals present that represent each level of the food chain. Construct a biotic pyramid from the information obtained. (references 2, 11, 13, 14, 20, 34, 43, 46)

Elementary and Secondary

11. Take your class fishing. Clean what you catch and have a fish fry. While you are cleaning the fish empty the contents of the fishes stomach into a clear jar half filled with water. Gently shake the sealed jar to determine what the fish was eating. Diagram the food chain that was discovered. Be sure to include man. (references 2, 11, 47)
12. Over the course of the school year have your students make a collection of various animals skulls. Using a "key," determine the species of animals that skull came from. How is the shape of the teeth related to the food habits of the animal?(references 11, 29)

Secondary

13. Examine the socio-economic interactions that take place within the various businesses of your community. Place these interactions in a food chain/food web perspective. What "feeding" levels does each business occupy? What happens when it goes out of business? Are there "limiting factors" that control the growth of one organism (business)?

Elementary and Secondary

14. Build bird feeders. Have the students design and build them in industrial arts class. Erect them in various areas around the school yard at various heights off the ground. Use different types of seed in the feeders to attract different species of birds. Keep records and make drawings of the various birds that use the feeders. Emphasize any adaptations the various species of birds might have that help them utilize a particular food source more effectively. (references 2, 11, 16, 26, 35, 45)

Secondary

15. Reproduce for your class excerpts from "Odyssey" pages 111-115 of *A Sand County Almanac* by Aldo Leopold. Discuss its application to nutrient cycling. What happened to the energy that was contained in each organism inhabitated by atom "x"? (reference 1)

Elementary and Secondary

16. English and Reading Class: Have your students review children literature and find as many examples as they can of this good-guy; bad-guy relationship. Have them rewrite those sections choosing words and ideas that will eliminate this prejudice.

Suggested Titles	**Author**
(Be sure the books you choose are the appropriate reading level for your students)	
Flight of the White Wolf	Mel Ellis
Charlotte's Web	Stuart Little
The Animal Family	Randall Jarrell
Abel's Family	William Steig
The Tough Winter	Robert Lawson
Old One-Toe	Michel-Amie's Baudouy
Long Horn	Joseph Wharton Lippincott
Simba	Jocelyn Arundel
Wapootin	Jane & Paul Arundel
The Big Goose & The Little White Duck	Meindert DeJong
Be Nice To Spiders	Margaret Bloy Graham
The Owl and The Prairie Dog	Berneice Freschet
The Magic Finger	Ronald Dahl

ENERGY IN THE ECOSYSTEM

Recommended Films

Conservation and Balance In Nature 18 min.—color

Investigates the dynamic balance in biological communities and man's role in changing those communities to obtain the resources he needs.

Source: International Film Bureau, 332 S. Michigan Ave., Chicago, Ill. 60604

Life in the Woodlot 17 min.—color

Emphasizes the relationship and interdependence of man, animals, and plants.

Source: State Museum, Room 25, Box 1868, Trenton, N.J. 08625

Natures Ever-Changing Communities 14 min.—color

Animation and graphics explore renewal, change and interdependence in nature.

Source: State Museum, Room 25, Box 1868, Trenton, N.J. 08625

Patterns of the Wild 28 min.—color

A fox-eyed view of the dynamics of a "natural"

ecosystem.

Source: State Museum, Room 25, Box 1868, Trenton, N.J. 08625

The Wood Ducks' World 31 min.—color

One of the few "real life" stories that accurately portrays the real life of its subject. Both beautifully and accurately done.

Source: Film Department, Ducks Unlimited, Inc., Box 66300, Chicago, Ill. 60666

NOTE: This reference list is a composite list that is used for teaching all five of the concept areas. The asterisked (*) references are to be used with this curriculum guide.

References

*1. *A Sand County Almanac*
Leopold, Aldo.
Oxford University Press, Inc., New York 1949.

*2. *American Wildlife and Plants: A Guide to Wildlife Food Habits*
Martin, Zimm, and Nelson
Dover Publications, Inc., New York 1951.

3. *Our Wildlife Legacy*
Allen, Durward
Funk and Wagnalls, New York 1954.

4. *Endangered and Threatened Wildlife and Plants*
U.S. Government Printing Office: 1979 Number 0-305-258.

*5. *Wildlife Biology*
Dasman, Raymond F.
John Wiley and Sons, Inc., New York 1964.

6. *Wildlife Habitat Improvement*
National Audubon Society, New York 1966.

7. *A Manual of Wildlife Conservation*
Teague, Richard D. Edit.
The Wildlife Society, Washington, D.C. 1971.

8. *Readings in Wildlife Conservation*
Bailey, James A., William Elder and Ted T. McKinney.
The Wildlife Society, 1974.

9. *Touch The Earth*
McLuhan, M.C.
Outerbridge and Dienstfrey Publication, New York 1972.

10. *Teaching For Survival*
Terry, Mark
Ballantine Books, Inc., New York.

*11. *Petersen's Field Guide Series* (for *Birds; Insects; Wild Flowers; Reptiles and Amphibians; Mammals; Butterflies* and others)
Petersen, Roger Troy. Editor
Houghton Mifflin Company; Boston.

*12. *Wildlife and America*
Brokow, H.P. Editor
Council of Environmental Quality; US Fish and Wildlife Service, US Forest Service and National Oceanic and Atmospheric Administration. 1978.

*13. *Animal Ecology*
Kendeigh, S.C.
Prentice-Hall, 1961.

*14. *Field Biology and Ecology*, 3rd edition.
Benton, A.H. and W.E. Werner Jr.
McGraw-Hill Book Co., New York. 1974.

*15. *Biology and Society*
Ehrlich, Paul R., Richard W. Holm and Irene L. Brown.
McGraw-Hill Co., New York. 1976.

*16. *How To Invite Wildlife Into Your Backyard*
Herzog, David Alan.
Great Lakes Living Press, Matteson, Ill. 1977.

17. *Guide To Wildlife Management Areas*
Division of Fish, Game, and Wildlife, P.O. Box 1809, Trenton, New Jersey 08625.

18. *Pennsylvania Teaching Guide to Natural Resource Conservation*
Department of Public Instruction. Harrisburg, Pennsylvania. 1964.

19. *Game Management*
Leopold, Aldo
Charles Schribner and Sons, New York. 1933.

*20. *Fundamentals of Ecology*
Odum, Eugene P.
Holt, Rinehart and Winston, New York. 1963.

21. *Principles of Game Management*
Madson, John and E. Kozicky
Olin Mathieson Chemical Corp., East Alton, Ill. 1962.

22. *Environmental Education Activities Manual*
Strapp, William B. and Dorothy A. Cox, Edit
Books 1-6 (by grade levels)
Strapp and Cox Publishers, Farmington Hills, Michigan. 1974.

23. *Teachers' Curriculum Guide to Conservation Education; Biology; Social Studies; Home Economics. (People and Their Environment Series).*
Brennan, Matthew T.
J.G. Furguson Publishing Co., Chicago, Ill. 1968.

24. *Wildlife Resources and The Natural Environment* (Course 200; Correspondence Courses in Agriculture).
Wingard, Robert G.
Pennsylvania State University, College of Agriculture, University Park, Pennsylvania.

25. *Environmental Education Teaching Resources; Projects For Environmental Problem-Solving*
National Education Association, Washington, D.C. 1975.

*26. *Manual For Outdoor Laboratories: The Development and Use of Schoolgrounds as Outdoor Laboratories For Teaching Science and Conservation*
Weaver, Richard L.
Interstate Printers and Publishers, Inc. Danville, Ill.

27. *Manual of Outdoor Conservation Education*
Shomon, Joseph J.
National Audubon Society, New York. 1964.

*28. *Teachers Rescurce Guide For Environmental Education*
Arizona Department of Education, Phoenix, Arizona

*29. *Mammals of Pennsylvania*
Pennsylvania Game Commission, Harrisburg, Pennsylvania

30. *Wildlife Management: Upland Game and General Principles*

Trippensee, Reuben E.
McGraw-Hill Book Co., New York. 1948.
31. *Our Northern Shrubs and How to Identify Them*
Keller, Harriet
Dover Publication Inc., New York. 1969.
32. *Common Weeds of the United States*
USDA
Dover Publications, Inc., New York. 1969.
*33. *Vanishing Wildlife of North America*
Allen, Thomas B.
National Geographic Society.
*34. *Ways of Wildlife*
Horwitz, Eleanor, Editor
Citation Press/Scholastic, New York. 1977.
*35. *Mans Responsibility for Nature Ecological Problems and Western Tradition*
Passmore, John
Charles Schribner's Sons, New York. 1974.
36. *The Wood Duck in Massachusetts*
Grice, David and John P. Rogers
Massachusetts Division of Fisheries and Game, Final Report. 1965.
37. *If Deer Are To Survive*
Dasman, William
Stockpole Books. 1971.
38. *A Conservation Saga*
Swift, Ernest
National Wildlife Federation, Washington, D.C. 1967.
*39. *African Genesis*
Ardrey, Robert
Antheneum Press, New York. 1961.
*40. *Ecology and Conservation Posters*
Number 12019, 12024 and Ecology Sign, Number 7167
Boys Scout of America, North Brunswick, New Jersey. 1975.
*41. *Hunting Hypothesis*
Ardrey, Robert
Antheneum Press, New York. 1976.
*42. *People of the Lake*
Leakey, Richard E. and Roger Lewin
Anchor Press/Doubleday, Garden City, New York. 1978.
*43. *Ecology and Field Biology,* 2nd Edition
Smith, Robert Leo
Harper and Row Publishers, New York. 1974.
44. *Ornithology in Laboratory and Field,* 4th Edition
Pellingill, Olin Sewall Jr.
Burgess Publishing Co., 1974.
*45. *Life Histories of North American Birds*
Bent, A.C.
US National Museum, Washington, D.C. 1919.
*46. *The New Field Book of Freshwater Life*
Klots, Elsie B.
Putnam Books, New York. 1966.
*47. *How To Catch Fish In Freshwater*
Fishermans Information Bureau
Chicago, Ill. 1967. (booklet)

APPENDIX I
GLOSSARY OF TERMS

Animal—a living organism that is not a plant. Generally it is not able to manufacture its own food and is capable of voluntary motion.

Biosphere—that area on earth which supports life.

Biotic Diversity—a relative measure of the complexity of an ecosystem determined by the number of different *species* (plant and animal) found in a community. Often *plant diversity* and *animal diversity* are discussed separately, but are directly related.

Biotic Potential—the maximum possible growth rate of an animal population (high birth rate, low death rate).

Biotic Pyramid—Herbivore—an animal that eats only plants. Carnivore—an animal that eats only meat (other animals). Omnivore—an animal that eats plants and meat.

Carrying Capacity—the number of animals (usually used for single species) that the habitat can support.

Community—all the plants and animal populations occupying a given area.

Conservation—the wise use of natural resources.

Consumer—an organism that uses the stored energy of another organism for food. Generally prefaced by a) primary (the first) or b) secondary (the second).

Cycle—fluctuations in animal populations as related to time and number of animals.

Decomposer—an organism that participates in the nutrient recycling process of decay.

Ecology—the study of the relationships that exist between living things and their environment.

Ecosystem—the combination and interaction of both the living and non-living aspects of community. This concept can be expanded to global situations or shrunk to microscopic proportions depending upon the context in which it is used.

Ecotone—the place where two major types of communities meet and blend together.

Endangered—a species whose prospects of survival and reproduction are in immediate danger.

Extinct—a species that has no living representative.

Food Chain—the path by which energy and materials are cycled through the environment. Eating and being eaten.

Food Web—complex combination of several to many food chains.

Habitat—the kind of place where living things (plants and animals) live.

Home Range—the area in which an individual spends all or most of its time.

Limiting Factors—the things in a habitat that are needed by an animal population, but are in short supply thus limiting the carrying capacity of the habitat.

Natural Resource—anything used that is not man-made. Renewable—able to reproduce itself; living Non-

renewable—unable to reproduce itself; non-living.

Niche—the function (i.e.: job or occupation) that an individual or species performs within a community.

Photosynthesis—the process by which complex organic materials are manufactured in plants using carbon dioxide and water as ingredients and sunlight as the energy source. More generally, the process by which sunlight energy is "captured" and "stored" in plants.

Plant—an organism that *is* generally capable of manufacturing its own food through photosynthesis (however there are non-photosynthesis plants, i.e.: mushrooms), and *not* capable of voluntary motion. (NOTE: in lower forms of life these characteristics do not always hold up).

Population—the total number of animals of a single kind (species) in both numbers and composition.

Population Dynamics—changes in a wildlife population over time in both numbers and composition.

Predator—an animal that survives by killing other animals for food.

Prey—an animal that is commonly killed by predators for food.

Primary Producer—an organism (plant) that changes sunlight energy into food energy that can be used by other organisms in the food-chain.

Rare—a species that is not persistently threatened with extinction but exists in such small numbers throughout its range that it may become endangered if its environment worsens.

Refuge—an area of land managed for the preservation of an animal species and/or its habitat.

Species—a class of individuals (plants or animal) having common characteristics. Usually associated with an organism that breeds "true to form."

Stress—(Shock Disease) a physiological response, within an animal, to adverse changes in the environment.

Succession—a sequence of communities which replace one another in a given area.

Territory—any defended area.

Turnover Rate—the rate at which new (young) individuals replace the old animals in a population.

Wildlife—an animal that is not dependent upon man for survival or that man does not intentionally take care of.

Wildlife Management—the science and art of changing the characteristics and interactions of habitats, wild animal populations, and men in order to achieve specific human goals by means of the wildlife resource.

NOTE:
The attached evaluation encompasses all the five topic areas within the project. If you have not received all of the topics, please fill out and return the evaluation for only those areas you have received.

SCHOOL NAME _____ GRADE _____

ADDRESS _____ AGES OF STUDENTS _____

TEACHERS NAME _____ NUMBER OF STUDENTS _____

NUMBER OF MALES _____

NUMBER OF FEMALES _____

1. Have you attended a Teachers Wildlife Workshop sponsored by the Division of Fish, Game, and Wildlife? yes____no_____
2. If you answered yes, please indicate the place and date.
   _____
3. Is Environmental Education part of your school curriculum?
   yes____ no____ If yes, what grade level?_____
4. Please indicate the order in which the Concept units were taught.
   (1 = first, 5 = last) Leave blank if unit was not taught.

   Energy in the Ecosystem_____
   Population Dynamics_____
   Wildlife as Envir. Indi._____
   Current Wildl. Problems_____
   Man's Manipulation of Ecosystems_____
5. In the future, would you teach the concepts units in the same order as above? yes____ no_____
6. If not, please indicate the order in which you would most likely follow in the future.

   Energy in the Ecosystem_____
   Population, Dynamics _____
   Wildlife as Envir. Indi._____
   Current Wildl. Problems_____
   Man's Manipulation of Ecosystems_____
7. Please indicate the amount of time spent on each concept and include field trips, etc.

   Energy in the Ecosystem_____
   Population Dynamics_____
   Wildlife as Envir. Indi._____
   Current Wildl. Problems_____
   Man's Manipulation of Ecosystems_____
8. In which subject areas were the concepts integrated?

	yes	no
Science	_____	_____
Math	_____	_____
Social Studies	_____	_____
Art	_____	_____
English	_____	_____
Other_____	_____	_____

9. Do you feel that using wildlife as a medium for teaching environmental education helped stimulate your students interest?
   yes_____ no_____
10. Did any guest speakers talk to your class as part of this program?
    yes_____ no_____
11. If you answered yes to the above question, please list below the speaker's name, affiliation and the topic of which he/she spoke.
12. Would you recommend this manual to other teachers for their use?
    yes_____ no_____
13. If you answered no to the above question, please state your reasons on the back of this page.
14. This manual discussed five environmental concepts. If there are other concepts that you would like to see included in this manual, please list them below.

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

15. Consider the entire environmental education manual. How would you rate the following aspects of the manual?

	adequate	inadequate (needs improvement)
discussion of ideas	_____	_____
explanation of terminology	_____	_____
wildlife examples	_____	_____
suggested readings and references	_____	_____
experiments	_____	_____
classroom activities and exercises	_____	_____
outdoor activities and exercises	_____	_____
suggested films and slides	_____	_____

16. If you indicated that any of the above areas need improvement, please explain your reasons as well as any suggestions that will help us in the space below.

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

Mail to:

Wildlife Education Unit
Division of Fish, Game & Wildlife
State Fish Hatchery
Hackettstown, N.J. 07860

The following section deals with each concept unit and the main ideas presented as part of that unit. The first column asks for an evaluation of the idea by the teacher. The second and third column asks for a judgement on your classes knowledge of the idea before and after this concept was taught. Please circle the appropriate response. Additional comments to help us improve this manual are welcomed.

STATEMENT	EVALUATION					PRIOR KNOWLEDGE				PRESENT KNOWLEDGE			
a = adequate i = inadequate	discussion	films/slides	classroom activities	outdoor activities	readings & references	excellent	good	fair	poor	excellent	good	fair	poor
ENERGY IN THE ECOSYSTEM													
the sun is the primary energy source for all life on earth	a i	a i	a i	a i	a i	e	g	f	p	e	g	f	p
all food & energy is derived from ecosystems	a i	a i	a i	a i	a i	e	g	f	p	e	g	f	p
life-death-birth is an energy transfer process upon which all organisms depend (including man)	a i	a i	a i	a i	a i	e	g	f	p	e	g	f	p
POPULATION DYNAMICS													
animal populations fluctuate in response to environmental influences (dynamic balance)	a i	a i	a i	a i	a i	e	g	f	p	e	g	f	p
animal populations are regulated by limiting factors	a i	a i	a i	a i	a i	e	g	f	p	e	g	f	p
wildlife is a renewable natural resource	a i	a i	a i	a i	a i	e	g	f	p	e	g	f	p
WILDLIFE AS AN INDICATOR OF ENVIRONMENTAL QUALITY													
the term "wildlife" includes all undomesticated animals both vertebrates & invertebrates	a i	a i	a i	a i	a i	e	g	f	p	e	g	f	p
animals exist in habitats which provide their living requirements	a i	a i	a i	a i	a i	e	g	f	p	e	g	f	p
man can use certain animals as indicators of environmental quality	a i	a i	a i	a i	a i	e	g	f	p	e	g	f	p
man too has living requirements which must be fulfilled in order to survive in a particular area	a i	a i	a i	a i	a i	e	g	f	p	e	g	f	p
CURRENT WILDLIFE PROBLEMS													
wildlife like other renewable resources can be harvested indefinitely if managed properly	a i	a i	a i	a i	a i	e	g	f	p	e	g	f	p
habitats can be managed to increase their ability to support wildlife	a i	a i	a i	a i	a i	e	g	f	p	e	g	f	p
wildlife species become endangered for several reasons—the most common of which is destruction of suitable habitat	a i	a i	a i	a i	a i	e	g	f	p	e	g	f	p
wide scale use of pesticides has adversely affected many wildlife species	a i	a i	a i	a i	a i	e	g	f	p	e	g	f	p
the "American standard of living" can both hinder & help the plight of endangered species	a i	a i	a i	a i	a i	e	g	f	p	e	g	f	p
MAN'S MANIPULATION OF ECOSYSTEMS													
animals exist in habitats which provide their living requirements	a i	a i	a i	a i	a i	e	g	f	p	e	g	f	p
man changes ecosystems to provide for his own living requirements	a i	a i	a i	a i	a i	e	g	f	p	e	g	f	p
when man changes ecosystems he also changes the wildlife populations that are associated with those ecosystems	a i	a i	a i	a i	a i	e	g	f	p	e	g	f	p
	a i	a i	a i	a i	a i	e	g	f	p	e	g	f	p

To keep up to date on the latest natural resource education materials, subscribe to New Jersey Outdoors—

—the seashore, beaches, boating, bathing
—the Kittatinny Mountains, hiking, camping, skiing, and natural areas
—over 250,000 acres of state parks, forests and historic sites
—over 145,000 acres of wildlife management areas
—fishing, hunting, birdwatching and the Pine Barrens

Many of these recreational activities are available to New Jerseyans free. Subscribe to *New Jersey Outdoors* and get wise to what's happening in your state. Complete subscription blank below and mail in today.

Get Wise To What's Happening In Your State

Subscribe to—

New Jersey Outdoors

- ☐ new
- ☐ gift
- ☐ renewal
- ☐ one year $4
- ☐ two years $7
- ☐ three years $10
- ☐ payment enclosed
- ☐ bill me

Make checks payable to—

NEW JERSEY OUTDOORS
P.O. BOX 1390, TRENTON, NJ 08625

NAME _____

ADDRESS _____

CITY _____

STATE _____ ZIP _____

GIFT FROM _____